Accelerated Program to Identify County's Urgent Drainage Needs

Gregg Farris
Snohomish County Surface Water Management Division

Steve Swenson
R. W. Beck, Inc.

John Rogers
CH2M HILL

Abstract

In less than two years, Snohomish County staff and two multidisciplinary consultant teams conducted an ambitious program to identify flooding, habitat, water quality and erosion problems and solutions within nearly all of the Urban Growth Areas (UGAs) in the County. This work will help guide decision making for the implementation of flooding prevention, habitat protection and enhancement, and other drainage-related community benefits in the areas of the county that have experienced, and will continue to experience, the most growth. Due to the size of the project, known as the Drainage Needs Report (DNR) project, the roughly 60-square-mile study area was divided into 11 individual study areas and watersheds. The analyses relied on an integration of high-accuracy GPS inventory data, GIS technology, stream and wetland habitat surveys, and detailed hydrologic and hydraulic modeling. Due to the magnitude of effort and the aggressive schedule for this project, the individual study areas were analyzed concurrently by a total of 13 consulting firms and county staff. The main products of this project included a list of recommended surface water projects with preliminary designs, an accurate inventory of existing drainage systems, and hydrologic and hydraulic models for many of the major conveyance systems.

Overview

Like many areas in western Washington, Snohomish County has experienced rapid change due to urban development in once rural areas. The drainage facilities in these recently urbanized areas are often a patchwork of pipes, roadside ditches and channels rather than a coordinated system as found in a mature utility. These conditions have highlighted the need for new information regarding urban drainage systems and related stormwater problems in the county's unincorporated Urban Growth Areas (UGAs). It has also focused attention on the need to develop solutions to address drainage issues, both now and in the future, as expected growth continues. The goal of the Drainage Needs Report (DNR) project has been to gain a better understanding of the drainage systems, streams, and wetlands in the unincorporated UGAs and to plan for future infrastructure needs in ways that will reduce road and property flooding, protect and enhance aquatic habitat, and reduce stormwater pollution.

This ambitious project involved the assessment of drainage needs in 58 square miles of unincorporated Snohomish County in only two years. The results provide a wealth of information and new tools that the county, local cities, developers, and citizens alike can use to make decisions on drainage related issues. These tools are designed to answer questions not only today but also in the future, as conditions change.

New Tools to Better Manage Drainage

The DNR project provides a set of practical tools that will help the county, developers, and property owners solve and avoid flooding and related surface water problems now and in the future. The main products of the DNR report include:

- The inventory of 58 square miles of existing drainage systems—mapped for the first time.
- The identification of over 1,000 existing and future surface water problems.
- A list of 378 priority projects with conceptual designs.
- The development of hydrologic and hydraulic models for a number of the major conveyance systems.
- 11 Drainage Needs Reports for individual study areas as well as an overall summary report.

The DNR project was primarily focused on identifying projects that reduce flooding by constructing a combination of conveyance and detention facilities that accommodate higher volumes of stormwater without overloading downstream drainage systems. Additional projects were also developed that help to improve or protect aquatic habitat, improve surface water quality, and reduce erosion problems.

Figure 1. The study areas for the 11 Snohomish County DNRs.

By inventorying and mapping complete drainage systems for the first time, locating present and future drainage problems, and identifying possible corrections, the county has the tools to take a comprehensive approach to managing urban drainage areas and solving the top priorities within them. The individual study area reports provide an understanding of conditions, problems, and reasonable solutions that can benefit a number of applications:

- Prioritize projects for Snohomish County's Annual Construction Program and 6-year Capital Improvement Program.
- Help new development identify drainage improvements needed to meet the Snohomish County drainage code
- Assist major regional and local government projects.
- Develop Habitat Conservation Plans to expedite county road and drainage projects in the south county or elsewhere.
- Coordinate drainage maintenance.
- Support county land-use planning.
- Target emergency response to spills.
- Support county compliance with state and federal regulations, such as NPDES.
- Provide public information.
- Provide new tools to evaluate drainage code updates or other development standards.

A Comprehensive Approach

Looking at All the Urban Areas
The DNR project area includes all of the unincorporated UGAs in the county except for the Lake Stevens UGA, where the county recently completed similar drainage evaluations. This overall DNR project area was divided into 11 individual study areas, as shown in Figure 1. In general, more detailed analyses were conducted for the larger UGAs that have experienced more development and have had a history of problems. A primary direction was to prioritize the evaluation efforts in the areas where most of the growth is occurring and to tailor the reports and analyses to the complexity of the areas and the likely drainage impacts.

Coordination

Due to the number of professionals who helped to complete the DNR project, coordination was extremely important. The study team included Snohomish County staff and two multidisciplinary consultant teams, led by R. W. Beck and CH2M Hill, which studied and analyzed the 11 DNR study areas concurrently and prepared 11 separate Drainage Needs Reports, a DNR Summary Report, and an Aquatic Habitat Summary report. Because the two consultant teams consisted of a total of 13 different consulting firms and because many of the analyses were conducted concurrently in different study areas, a number of specific protocols were developed to help ensure consistency. Specific protocols were developed for hydrologic modeling, hydraulic modeling, aquatic habitat stream inventories, aquatic habitat assessments, water quality analyses, cost estimating procedures, and document preparation. Most of these protocols are documented in a separate report entitled Drainage Needs Reports Protocols.

To further ensure a consistent and coordinated effort in each study area, lead staff members were assigned for specific purposes. One lead staff member was assigned for each of the 11 study areas and one lead staff member was assigned for each technical area of the project, which included hydrologic modeling, hydraulic modeling, aquatic habitat, water quality, drainage inventory, geographic information systems (GIS), and geomorphology.

An Integrated Approach to Evaluating Problems

A variety of federal, state and local laws require storm drain systems to discharge water that is clean and does not damage the natural waters to which it drains. Increasing urbanization can result in increased runoff, which can erode streambanks and damage streambeds. More recently, the listing of Puget Sound chinook and bull trout as a threatened species under the Endangered Species Act has made drainage solutions more complex to evaluate and often more difficult to implement. For example, new regulations require coordination and cooperation of various engineering and scientific disciplines and regulatory agencies. To install a larger drain pipe to alleviate a flooding problem involves analysis of changes in the stormwater flow (both upstream and downstream) and evaluation of the potential impacts to fish habitat and fish migration. Often, compliance with the conditions of required permits from the regulatory agencies dictates the scope, schedule, and cost of the work. As a result, while this project largely focuses on drainage and flooding issues, it must also consider other issues that are inextricably intertwined, such as aquatic habitat, water quality, and erosion.

Recognizing this reality, the DNR project team adopted a comprehensive approach to address these related issues. For the larger study areas, the analyses included flooding, habitat, water quality, and in some cases, erosion. The only exceptions were in the smaller study areas where the focus was primarily on flooding issues. The team's approach relied on an integration of high-accuracy inventory data, GIS technology, stream and wetland habitat surveys, and detailed hydrologic and hydraulic modeling for many of the major conveyance systems.

For the drainage inventories, most of the inventory data was collected using high-accuracy global positioning system (GPS) equipment, though more conventional surveys were also conducted as needed in some areas. The collected data was downloaded directly into a GIS environment in order to be able to access the data and create maps more easily.

The general approach to the aquatic habitat analyses included conducting stream inventories, collecting available habitat information, identifying observed problems, and evaluating potential solutions. A multimetric model was also developed to help qualify the overall habitat condition within each stream through a comparison with reference conditions and to help prioritize the recommended habitat projects in different study areas.

To identify flooding problems, drainage complaints made to the county by residents were reviewed, and over 100 hydrologic and hydraulic computer models were developed for most of the major stream and drainage conveyance systems in the study areas. All of the hydrologic models were developed using the continuous simulation HSPF program and many were calibrated using historical flows recorded by existing flow gauges. The hydrologic models determined the amount of stormwater runoff that will be generated by various storm events within a drainage basin, based upon both current development conditions and future buildout according to the Future Land Use Map adopted in Snohomish County's 1995 Comprehensive Plan. Detention ponds that would be installed by future developers were accounted for in the HSPF models according to the detention standards under the county's existing drainage code. Some of the input (i.e., the PERLND tables) for the HSPF models was generated using GIS programs that Snohomish County developed that overlay and combine different geographic information, such as land use, soils, streams, and critical areas.

The hydraulic models used the flow information from the HSPF models to determine how the runoff travels through the system of stream channels and drain pipes, and to identify where flooding problems will occur for both existing and future land use conditions. A variety of hydraulic models (including HEC-RAS, SWMM-Extran, and HY-8) were used to

analyze the unique conditions of the existing drainage systems. The hydrologic and hydraulic models were then used to evaluate solutions to the identified flooding problems, which involved analyzing various alternatives including increasing conveyance capacity, adding detention storage, and adding high-flow bypass systems.

General Results and Conclusions

Inventorying/Mapping the Public Drainage System
The DNR project developed an inventory of the existing drainage systems in all of the individual study areas, which is now contained in the county's GIS. Including roughly 15 square miles of inventory conducted by Snohomish County prior to the DNR project, the county's drainage inventory now covers a total of 73 square miles. The total current inventory includes nearly 600 miles of enclosed pipes, 400 miles of open channels, 70,000 catch basin and pipe features, and 140,000 ditch and stream cross-section points. While this information was used to support the hydrologic and hydraulic modeling analyses, it also created an accurate and complete record of the existing drainage systems.

Hundreds of Flooding Problems Identified
Of the more than 1,000 surface water problems identified by the 11 Drainage Needs Reports, 591 flooding problems were identified for the priority areas studied in the Urban Growth Areas. These flooding problems were identified by constructing detailed computer models, reviewing recent drainage complaints recorded by the county, talking with local residents, and interviewing county staff. The majority of the problems are associated with undersized culverts and drainage pipes, many of which are located on private property.

Based on the analyses, the following general conclusions stand out:
- Flooding problems tend to be concentrated in the older drainage systems that were designed prior to the current county standards.
- Fewer flooding problems occur in areas where more modern drainage systems are in place.
- As development occurs, the remaining undeveloped areas will need significant drainage system improvements.
- Previous drainage system improvements installed by Snohomish County, in accordance with the county's current drainage standards, seem to be working well.
- In the smaller UGAs where unincorporated land is small and often fragmented, the DNR studies have isolated specific problems, but it is important to recognize that many of these problems cross boundaries between unincorporated and incorporated land and between adjacent study areas.
- In general, stormwater flows are predicted to increase in most areas where future development would occur. Although Snohomish County's current drainage standards require new development to control the surface water leaving a site, stormwater flows are predicted to increase within the basins as a result of the additional impervious areas.
- For those drainage pipes that are undersized and hold back a large volume of stormwater during rainfall events, replacing these pipes with larger ones will send more water downstream and could create new downstream problems. In such cases, stormwater detention is generally recommended to offset the increase in flows that would occur by replacing these drainage pipes.
- Providing regional detention ponds is preferred over increasing conveyance capacities, and detention pond options were the least-cost option when they did not require removing residential structures or impacting sensitive areas.
- Some opportunities were found to retrofit existing detention ponds to provide water quality treatment or to increase the detention volume in the pond (though often the increased volume was only marginal).
- Follow-up work with property owners for their correction of flooding problems on private property will benefit basin drainage conditions and conveyance capabilities.

Habitat Impacted by Development
Based on the stream inventories and analyses, the following general conclusions regarding habitat conditions are noteworthy:
- As expected, habitat conditions along the existing streams, particularly in the more developed UGAs, were generally poor as a result of impacts from urbanization in these basins.
- Many of the identified habitat problems are due to culverts that were not designed to allow fish passage.
- Many streams have inadequate riparian vegetation along their banks, resulting in excessive erosion.
- Additional pools and improved shade along stream corridors would improve habitat conditions.
- Many culverts that create fish passage problems also cause flooding problems, so replacing these culverts would solve multiple problems.

Water Quality and Erosion Need Improvement

Water quality and erosion analyses were generally more limited than the flooding analyses and habitat assessments. However, based on the analyses conducted, the following general conclusions are warranted:

- Overall, the water quality in many areas was found to be poor according to Washington State water quality standards.
- Natural rates of erosion and sedimentation have been accelerated in many locations as a result of increased stormwater from upstream development.
- Many of the water quality problems are typical of urbanizing areas with new construction, additional impervious areas, and changes in hydrology.
- Many of the water quality problems could be reduced through preventive measures such as street cleaning and best management practices for construction and farming.
- Retrofitting existing detention facilities could, in many cases, help to improve both flooding and water quality problems.

Beneficial Uses of New Information

The individual study area reports provide new information for the county that otherwise would not have been available for many years. The inventory and modeling, in particular, provide a reference to the existing conditions and a capability to evaluate impacts resulting from further development within the basins, as well as how those impacts can best be mitigated.

The hydrologic models predict basin flows for current conditions and at complete buildout of the current comprehensive land use plan. The hydraulic models represent system capacities for current and future flows. The hydraulic models also identify conveyance improvements, and these models can be modified later to account for changes to the drainage system.

Although it was not necessary to model all areas within the basins, especially those with no known problems, there is now background information and modeling that facilitate designs within new areas. The modeling further provides the opportunity to compare drainage impacts of different land use patterns and various growth scenarios.

Table 1 lists each DNR product and shows that it can be used for a number of beneficial purposes.

Table 1. Beneficial Uses of the DNR Products.

DNR Product	Beneficial Uses
1. Inventory of Existing Drainage Systems	• The county will have a better record of its drainage systems for maintenance purposes. • Developers conducting a downstream analysis will be able to use this information in their analyses. • The emergency response to contain spills will be able to more quickly trace downstream drainage paths. • Local residents will be able to better understand the drainage systems in their local neighborhood.
2. Identified Surface Water Problems	• Developers conducting a downstream analysis will be able to use this information in their analyses. • The county will also be able to use this information in its Title 24 review of the downstream analyses.
3. List of Recommended Projects	• Top priority projects can be selected and implemented to solve historical and/or predicted problems due to buildout of current land use plans. • Projects could be proposed as mitigation opportunities for large regional projects. • Projects could be used in the design of county roadway projects to help minimize impacts. • Identified habitat projects could be used for the Habitat Conservation Plan (HCP). • Projects and identified problems could be used in Title 24 review of proposed developments. • Private property owners may wish to implement projects to fix problems on their property.
4. Preliminary Project Designs	• Whoever implements a given project will have a better starting point for completing final designs and obtaining needed permits.
5. Hydrologic & Hydraulic Models	• Developers conducting a downstream analysis will be able to use these models in their analyses. • The county will be able to evaluate effects of proposed changes in regulatory standards, such as an update to the drainage code. • County engineers can identify drainage solutions for road projects. • The county and developers will have a better starting point for completing final designs and obtaining needed permits.
6. Individual Drainage Needs Reports	• The county will be able to document how problems and projects were identified and whether additional analyses will be needed in the future. • Local residents will be able to better understand the main surface water problems and issues in their neighborhood.

Individual Study Areas

In addition to the general conclusions for the entire project, general conclusions were also reached regarding some of the individual study areas. Table 2 summarizes some of the main results or conclusions for each study area.

Table 2. General Conclusions on the 11 DNR Study Areas.

DNR	General Conclusions about the Basin
Quilceda Creek (DNR No. 1)	Most of the flooding problems in this basin can be attributed to the numerous small and undersized culverts on tributaries and ditches. The flat geography and the high groundwater table compound flooding problems.
Swamp Creek (DNR No. 2)	Many of the flooding problems have occurred due to the incremental development of the area, where existing drainage systems and streams are unable to handle the increased stormwater. Most of the flooding is due to undersized pipes and channels. Relatively few flooding problems occur along the main stem of Swamp Creek, due in large part to the significant riparian wetlands that ameliorate potential flooding problems and provide water quality and habitat benefits.
North UGAs (Arlington, Darrington, Granite Falls) DNR No. 3)	The study confirmed that historical drainage problems (if any were on file) had been closed and no existing drainage problems were identified.
Marshland Tributaries and Sunnyside Creek (DNR No. 4)	Many of the drainage systems in the developed plateau area of the Marshland tributaries are older piped systems that lack sufficient conveyance capacity. Erosion and habitat problems are significant in the Marshland sub-basin. The Sunnyside Creek study area had no identified flooding problems along the main stem of the creek.
Snohomish UGA (DNR No. 5)	Relatively few flooding problems were identified in this basin; habitat and water quality problems were more numerous. Upsizing culverts would solve a number of the flooding and habitat problems.
East Valley UGAs (Monroe, Sultan, Gold Bar) (DNR No. 6)	Relatively few flooding problems were identified in these primarily rural areas; most of them were located in the Monroe UGA study area.
Stanwood UGA (DNR No. 7)	Less than ten flooding problems were identified in this primarily rural area. Problems typically included clogged culverts and pipes with insufficient conveyance capacities.
Allen Creek (DNR No. 8)	Flooding problems were identified in the older residential developments and along the northern main stem of the creek, although the number of problems was fewer than expected. Habitat along the main stem is poor. The greatest opportunity to improve the system's habitat, solve some significant drainage problems, and improved water quality would result from a relocation of the northern main stem. The computer analysis showed that recently constructed stormwater facilities designed to meet current standards in the study area are generally working as planned.
Little Bear Creek (DNR No. 9)	Flooding problems in this urbanizing area are the result of undersized pipes and channels in the developed areas of the basin and/or blocked pipes that are clogged with sediment and vegetation.
North Creek (DNR No. 10)	Most of the flooding occurs at roadway culverts and in neighborhoods in the upland areas along the tributaries, where drainage systems are undersized. There were relatively few widespread flooding problems along the main stem, except in the Bothell area.
Puget Sound Tributaries (DNR No. 11)	A number of flooding problems were found in the developed areas as a result of undersized culverts. This study area also has a history of erosion-related problems because of natural processes in the steep ravines; however, development has exacerbated these problems.

Recommended Solutions

Appropriate and reasonable solutions were developed for many of the significant problems that were identified. As previously mentioned, the project focused on capital project solutions, though non-capital project solutions such as maintenance and best management practices were also recommended where appropriate.

Hydrologic and hydraulic models were created to evaluate the drainage systems, identify future flooding problems, and select appropriate improvements. Potential projects were typically modeled for two basic alternatives: (1) solutions relying primarily upon increasing the capacity of the conveyance system, and (2) solutions relying primarily upon a combination of conveyance improvements and maximizing the water storage available in the basin. In this manner the most cost-effective solutions were identified.
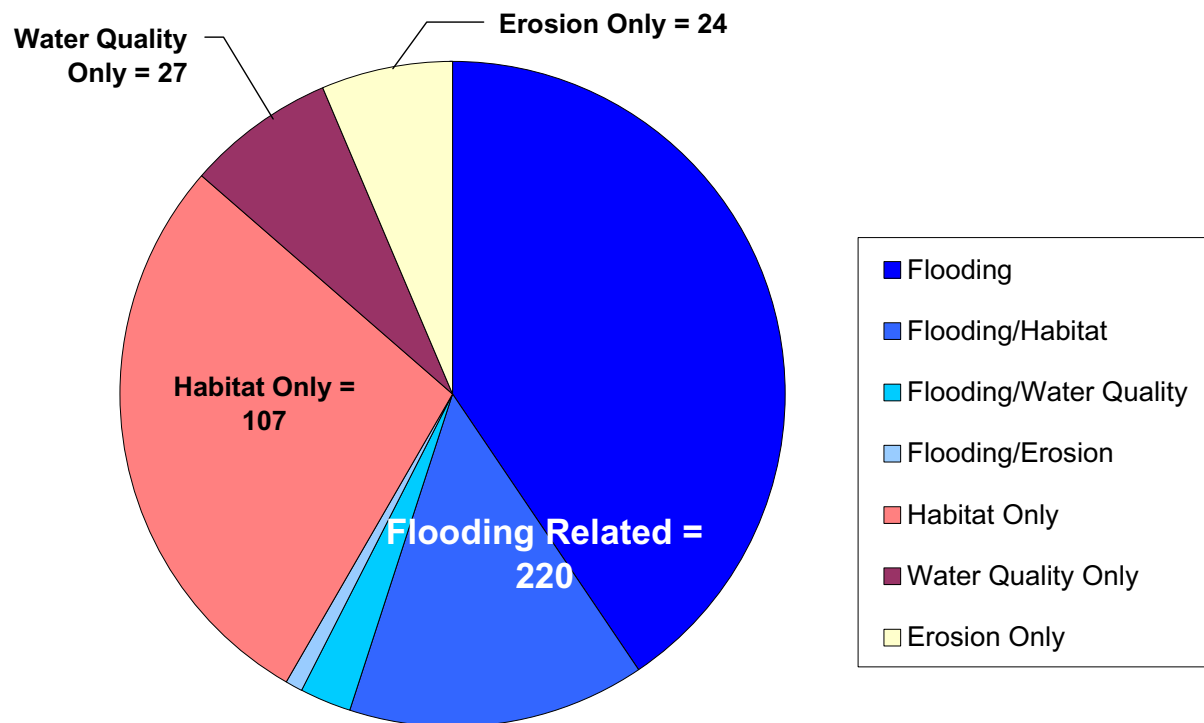
Recommended Projects

Combining all of the recommended projects for the 11 study areas, the reports identify 378 projects with an estimated cost of roughly $123 million. These projects correct flooding problems, enhance habitat, and reduce stormwater pollution. Because current county code does not require that any of the recommended projects be implemented, the county will need to determine which projects will be funded using available or additional revenue and the priority or order of construction. Section 5 below discusses a possible process to define implementation priorities and funding opportunities.

Table 3 and Figure 2 summarize the total number of recommended projects for each study area, while Table 4 and Figure 3 summarize the total costs of the projects. As indicated in these tables and figures, the recommended projects were divided into different categories according to the main types of problems that they would address. Four of these categories are for projects that primarily address only one type of problem: flooding, habitat, water quality, and erosion. The other categories represent projects that address more than one type of problem, including flooding and habitat, flooding and water quality, or flooding and erosion. A typical project that would address both flooding and habitat problems is a culvert replacement that addresses both a flooding and a fish passage problem. An example of a project that addresses both flooding and water quality problems is the retrofit of an existing detention pond to provide water quality features and to expand the existing detention volume. A typical example of a project that addresses both flooding and erosion issues would be a regional detention pond that reduces downstream flows to help solve both types of problems.

As indicated in Figure 3, the recommended projects in this study addressing one or more flooding problems represent 69 percent of the cost of all projects.

Table 3. Total Number of Recommended Projects, by DNR.

| DNR	Study Area	Type of Project							
		Flooding	Flooding & Habitat	Flooding & Water Quality	Flooding & Erosion	Habitat	Water Quality	Erosion	Total
1	Quilceda Creek	33	22	0	0	31	4	1	**91**
2	Swamp Creek	35	10	5	0	14	5	0	**69**
3	North UGAs	0	0	0	0	0	0	0	**0**
4	Marshland Tributaries & Sunnyside Creek	12	4	3	0	10	3	11	**43**
5	Snohomish UGA	1	0	0	0	9	5	0	**15**
6	East Valley UGAs	7	0	0	0	12	0	3	**22**
7	Little Bear Creek	4	0	0	0	1	0	1	**6**
8	Allen Creek	7	8	0	0	10	2	2	**29**
9	Stanwood UGA	9	1	0	1	0	0	0	**11**
10	North Creek	34	9	1	0	13	7	0	**64**
11	Puget Sound Tributaries	11	1	0	2	7	1	6	**28**
Total		**153**	**55**	**9**	**3**	**107**	**27**	**24**	**378**

Figure 2. Number of recommended projects, by project category.

Table 4. Total Costs for Recommended Projects, by DNR (in $thousands).

DNR	Study Area	Type of Project							
		Flooding	Flooding & Habitat	Flooding & Water Quality	Flooding & Erosion	Habitat	Water Quality	Erosion	Total
1	Quilceda Creek	$4,974	$20,103	$0	$0	$7,668	$514	$145	**$33,404**
2	Swamp Creek	13,023	2,245	6,289	0	6,001	744	0	**28,302**
3	North UGAs	0	0	0	0	0	0	0	**0**
4	Marshland Tributaries & Sunnyside Creek	2,893	1,439	1,787	0	1,211	884	5,430	**13,644**
5	Snohomish UGA	236	0	0	0	1,863	386	0	**2,485**
6	East Valley UGAs	796	0	0	0	1,753	0	119	**2,669[a]**
7	Little Bear Creek	115	0	0	0	51	0	47	**213**
8	Allen Creek	2,559	6,017	0	0	2,471	340	412	**11,799**
9	Stanwood UGA	828	100	0	107	0	0	0	**1,035**
10	North Creek	8,821	7,768	1,699	0	4,387	1,104	0	**23,779**
11	Puget Sound Tributaries	1,443	433	0	877	1,656	143	712	**5,264**
Total		**$35,688**	**$38,105**	**$9,775**	**$984**	**$27,062**	**$4,115**	**$6,865**	**$122,594**

a. Total of rounded numbers does not match rounded total of numbers. Estimated project costs are provided in Appendix B of the DNR Summary Report.
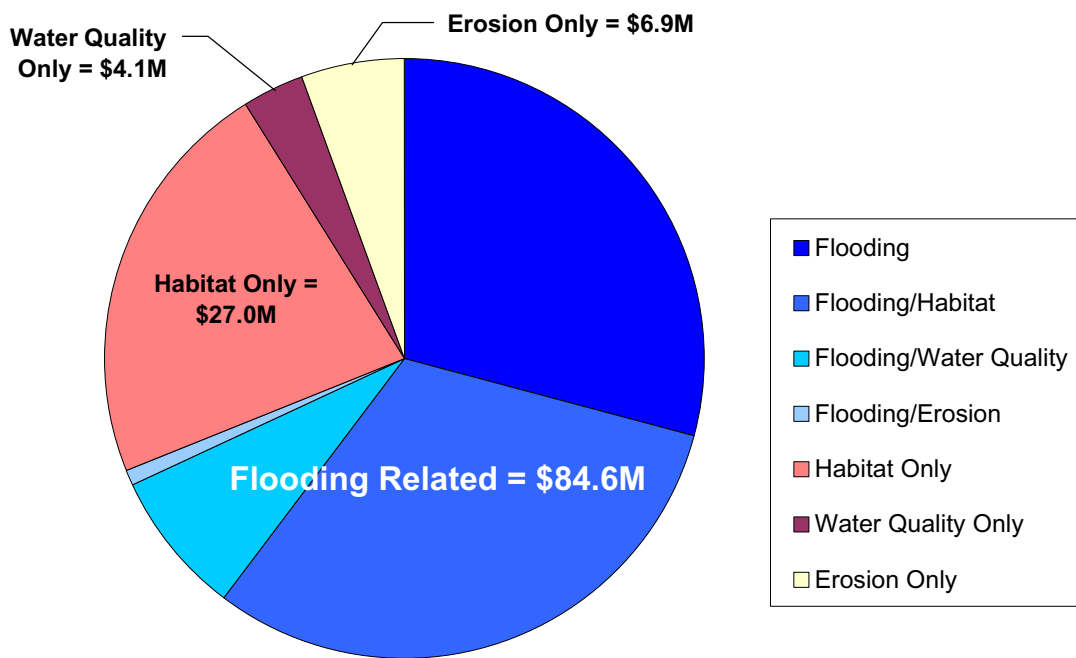
Figure 3. Costs of recommended projects, by project category.

Non-Project Recommendations

In addition to the recommended list of projects, some non-project recommendations were also made in certain situations where these types of solutions would be more appropriate or more cost-effective. Examples of some of these types of recommendations include:

- Continue to regularly maintain existing drainage systems, particularly on roadways with heavy traffic and therefore higher pollutant levels.
- Conduct routine sweeping of public parking lots and high-use roadways to reduce pollutants in these areas.
- Promote best management practices to improve water quality.
- Coordinate with local cities and agencies to implement recommended projects.
- Conduct supplemental studies as drainage problems develop in new areas, or as there are changes in land use plans or design standards.

Next Steps Toward Implementation

Using the list of recommended projects, the next phase of this project will involve selecting and implementing the highest priority projects. An implementation strategy needs to be defined that is based upon a policy framework representing reasonable county funding capabilities and supportive of further development within the Urban Growth Areas.

A $123 million capital program is certainly beyond current funding capabilities; however, modest revenue increases and other agency support could make significant progress in implementing DNR projects during a 20-year capital improvement program. The next steps toward project implementation begin with identifying county council priorities for stormwater projects, reviewing funding capabilities, and creating an effective Annual Construction Program and 6-year Capital Improvement Program. Some of the main steps in this process are anticipated to include:

- **Select Highest Priority Projects for Implementation:** The county will need to develop an approved method to prioritize projects for implementation that reflects county council policy direction. The individual DNR reports provide some guidance regarding how technical issues, such as flooding frequency, could be used to help prioritize projects. Other issues, such as geographical balance, funding equity, sequencing project construction, and permitting, should also be considered in this selection process, consistent with Council policy concerns. Department staff would then use the Council-approved methodology to rank projects quickly.

- **Determine Available Funding:** The county will need to determine how much funding will be available to implement the highest priority recommended projects. A full range of financial resources should be considered,

such as REET (real estate excise tax), construction support from other capital programs (such as roads), interlocal agreements with adjacent cities, mitigation from major government construction projects (such as Brightwater), and increased surface water fees.

- **Adopt a Drainage Construction Program:** Based on the priority list and funding outlook identified above, the county would immediately align its Annual Construction Programs for 2003 and 2004. The county would then develop a 6-year Capital Improvement Program, and later create a 20 year drainage Capital Facilities Plan as a supporting analysis for the county's Comprehensive Plan Update (which plans through 2025).

Following the completion of the DNR project, Snohomish County adopted a temporary increase in its surface water fees for the southern UGAs in the county that are more densely populated. This two-year increase is intended to design and construct some of the higher priority projects that address flooding problems in this part of the county.

Providing for the Future
The county now understands and can address the surface water systems in the Urban Growth Areas. The Drainage Needs Reports are living documents that can continue to provide information and tools for Snohomish County's drainage needs as the county continues to meet the demands that growth brings and deals with current problems and future needs. These reports provide a list of 378 projects that provide a collection of preferred solutions to solve flooding problems and opportunities to improve habitat, water quality and erosion conditions. These projects will be used to define capital investments and evaluate investment options to protect people, property and the environment.

Additional Information Available
Currently, many of the DNR reports and drainage inventory maps are available on Snohomish County's Web site. Each of the 11 individual study area reports and the DNR Summary Report, along with other information about the DNR project, can be viewed and downloaded from the following Web address:

> **http://www.co.snohomish.wa.us/publicwk/swm/drainage/dnr/index.htm**

Maps showing the county's current drainage inventory information can be viewed at the following Web address:

> **http://www.co.snohomish.wa.us/publicwk/swm/maps/drainage/index.html**

Additional reports, including the Drainage Needs Report Protocols and the Aquatic Habitat Summary, can also be obtained from the county. Contact Gregg Farris (425-388-6454 or gfarris@co.snohomish.wa.us) for additional information about obtaining these reports.